REMARKS

Favorable reconsideration of the above-identified application, in view of the foregoing amendments to the description and Abstract, and the amendment to the drawing detailed hereinafter, and in view of the following remarks, is respectfully requested.

The description has been amended at page 7, paragraph 19 to clarify antecedents. The Abstract has been amended to reduce it to less than one hundred and fifty words.

With reference to the drawing amendment, a corrected drawing sheet is submitted herewith in which FIG. 1 has been amended to correct the labeling of overload shunt 40 from "overloaded shunt" to "overload shunt". A copy of the original drawing sheet containing FIG. 1 is enclosed with this correction indicated in red ink thereon.

Turning to the Examiner's claim rejections as set forth in Sections 2, 3 and 4 on pages 2 and 3 of the Action, claims 1, 3-5, 7-8, 10-12 and 14 have been rejected under 35 USC §103 (a) as allegedly being unpatentable over the Phillips U.S. Patent 5,307,892. It is respectfully submitted that this rejection is in error both in fact and law, and therefore should be withdrawn. In rejecting claims 1 and 4, the Examiner states that:

> "....Phillips teaches a torque transducer that includes: a first torsion bar 69 (fig.2) and a second stage torsion bar 68 (fig.2) connected in series (col.9, lines 12-16); a torque sensor 100a (fig.2) at the second stage torsion bar for measuring input torque (col.10, lines 12-26). Phillips does not explicitly teach detecting torque as a function of stress in the second torsion bar...."

However, it is clear from the Phillips '892 description and FIG. 2 of Phillips '892 that Phillips discloses and teaches only <u>one</u> torsion bar in the steering unit of FIGS. 2 and 3, namely torsion bar 68 that is provided with a reduced diameter torsionally compliant section 69. The axially opposite torsionally non-compliant end portions of torsion bar 68 are of larger diameter and equal in diameter to one another in accordance with conventional torsion bar construction.

Phillips points out that the torsionally compliant section 69 of torsion bar 68 is "made much stiffer" in comparison to the correspondingly torsionally compliant section of torsion bar 25 shown in the Haga et al U.S. Patent 4,452,274 (cited in Phillips '892 at column 9, lines 10-16 and column 10, line 56). A copy of Haga et al. 4,452,274 is enclosed herewith for the convenience of the Examiner. It will be seen that column 9, lines 1-16, Phillips '892 is comparing the Phillips '892 system with the Haga et al. '274 system, and points out at column 9, lines 4-16 of Phillips:

> "The input torque is transmitted to pinion shaft 64 via a pin 66 and a rotationally compliant member such as torsion bar 68 in a manner similar to that utilized in many conventional rotary power steering valves. It will be noted that these components and their utilization generally follow similar components as disclosed in U.S. Pat. No. 4,452,274 (Haga et al.). However, <u>torsion bar 68 is depicted with a much stiffer compliant section 69</u>. The increased stiffness is indicative (of) an electronically controlled power steering system 10 (that) has much improved tactile input characteristics, ass will be detailed below." (underscoring added)

Thus, Phillips in the '892 patent is comparing his torsion bar 68 to Haga et al. torsion bar 25. In Phillips torsion bar 68 the reduced diameter "much stiffer compliant section 69" is much shorter axially relative to the overall length of Phillips torsion bar 68 than the corresponding axial length of the reduced diameter torsionally compliant section of the Haga et al. torsional bar 25. Consequently, because of its much shorter axial length, the reduced diameter torsionally compliant section 69 of the Phillips torsion bar 68, for a given value of applied torque, will exhibit much less angular deflection between its axially opposite ends than will the much longer reduced diameter compliant section of torsion bar 25 of Haga et al. '274. Thus Phillips states that his torsion bar 68 is depicted with "a much stiffer" compliant section 69 (i.e., "rotationally compliant" per column 9, line 7 Phillips '892).

Thus, contrary to the Examiner's interpretation of Phillips, there is only one torsion bar, namely torsion bar 68, disclosed in Phillips, and this torsion bar 68 has only one

reduced diameter torsionally compliant section 69. Hence, the Examiner's assertions that section 69 constitutes a "first torsion bar" and that torsion bar 68 is a "second stage torsion bar" are factually incorrect.

Moreover, steering torque is applied to input shaft 62 at its right hand end (not at its left hand end), as viewed in FIG. 2, by a conventional steering column coupling, undoubtedly a spline coupling as is apparently shown in FIG. 2 of Haga et al. '274. In the Phillips '892 arrangement the operator/driver generated input steering torque from the steering column being applied to the input end of input shaft 62, is transferred through an alignment pin 66 to the input end of torsion bar 68. The output end of torsion bar 68 is non-rotationally fixedly secured to the input end of pinion shaft 64 by an interference fit (Phillips '892, column 9, lines 24-26). The steering torque is then transmitted via pinion gear 70 of pinion shaft 64 to the steering rack 72 of the steering linkage.

In operation of Phillips steering unit 14, the sleeve-type input shaft 62 is basically unstressed inasmuch as its output end has three teeth 96a,b,c that loosely interfit or mesh with three teeth 98a,b,c provided on the input end of pinion shaft 64 (see also Phillips FIG. 3). The angular clearance between each pair of these loosely intermeshed teeth is designed to accommodate the normal maximum twist of compliant section 69 relative to the surrounding unstressed sleeve shaft 62. The angular extent of such twist is measured by the torque proximity sensors 100a, 100b mounted into the loosely coupled teeth of the input shaft 62 and pinion shaft 64.

Hence, as torsion bar 68 is twisted this twist will be seen essentially as the angular deflection strain occurring only in compliant section 69 between its axially opposite ends caused by a given applied torsional stress as resisted by the reaction forces from rack 72 (reflecting the

steering load versus the operator-generated steering torque applied via pin 66 to the input end of torsion bar 68). As this twist occurs the teeth 98a,b,c will angularly shift relative to the teeth 96a,b,c of the surrounding input sleeve shaft 62. This angular shift in turn is measured by the proximity sensors 100a, 100b to develop an electrical signal for use in the complex Phillips electronic system for applying steering assist hydraulically or electrically.

In view of the above teaching and disclosure of Phillips, it is evident why, as the Examiner admits, "Phillips does not expressly teach detecting torque as a function of stress in the "second" torsion bar". The Examiner erroneously considers the portion of torsion bar 68 extending axially between the right hand end (as viewed in Phillips FIG. 2) of compliant section 69 and the input end at pin 66 of torsion bar 68 as being a "second torsion bar". However in Phillips the detecting of torque as a function of torsional stress-induced angular strain ("twist") is detected at the extreme left hand or torsionally compliant output end of torsion bar 68 by measuring only that twist or angular deflection occurring between the opposite axial ends of the reduced diameter torsionally compliant section 69 of torsion bar 68. The two larger diameter axially opposite end portions of torsion bar 68, because of their greater diameter relative to the one and only compliant section 69, do not, in and of themselves, internally twist in operation by a measurably significant amount.

Thus, nowhere in Phillips '892 is there disclosed, shown or suggested a torsion bar or bars providing two axially spaced compliant sections coupled in series in torque transmitting relationship between a steering column input and a pinion shaft output, much less a torsional stress relationship therebetween wherein the first stage compliant section has a higher torsional stress in torque transmitting operation than the series coupled second stage torsion bar. Indeed, arguendo, even if Phillips were incorrectly construed as the Examiner depicts as providing two

torsion bars, so that the axially longer and larger diameter input portion of torsion bar 68 were considered to be the "first stage torsion bar", the two stages would be completely opposite from applicants' relationship of the first and second stage torsion bars connected in series wherein the first stage has a higher operational torsional stress than the second stage when transmitting the same amount of torque in series therethrough.

Clearly Phillips is completely devoid of any disclosure or suggestion of applicants' novel system concepts wherein a first torsion bar stage is constructed to have a failure mode at a lower stress level than the series-coupled second stage torsion bar stage, and thus is provided as a sacrificial "weak link" in the torque transducer. Therefore, if a stress related failure ever occurs, it will occur only in the first stage. Such failure in the first stage in turn will prevent any torque from reaching the second stage torsion bar. With zero input torque to the second stage upon first stage failure, the torque sensor will see only zero strain, thereby providing a system that is fail-safe because only a "zero" torque signal can be generated in the event of torsion bar failure, thereby avoiding the vehicle instability problem described in Paragraph 0005 of applicants' description. Moreover, in normal operation, the first stage torsion bar may be used to provide the low torsion rate for tuning of the steering system, i.e. to tune by initial design the system dynamics or "feel" and response for the steering system.

The Examiner also states, in Section 3 of the Action that: "However, using a sensor for detecting torque as a function of stress would have been well known." Indeed, Phillips '892 shows implementing a sensor at the output end of torsion bar 68 to measure or detect torque as a function of stress in this single torsion bar 68 as disclosed. However, this alone does not lead to the inventive concepts as disclosed.

The Examiner then states: "Further, implementing a sensor at a specific section of a torsion device to measure the torque acting on the interested section requires only routine skill in the art." While this statement may be true, it also begs the question. This asserted implementation does not suggest or teach applicants' concepts as claimed for providing a fail-safe system for protecting a torque-sensing device from unstable operation in the event the torsion bar breaks. Nor does Phillips disclose or suggest applicants' claimed series-coupled differential stress level torsion bars wherein the first stage can be used to tune the system dynamics (feel), and the second stage utilized to provide a proportional strain that opens the hydraulic control valve for the power assist system.

The Examiner then goes on to state, in Section 3, beginning at the bottom of page 2 and continuing on page 3 of the Action that: " It would have been obvious to a person of ordinary skill in the art at the time the invention was made to couple a stress sensor to the "second" torsion bar 68 (fig.2) in order to determine torque acting on the second torsion bar." Whether or not this would have been obvious to a person of ordinary skill in the art is moot in view of the fact that applicants do not claim coupling a stress/strain torque sensor to such a "second torsion bar 68", which in the Examiner's interpretation has to be that portion of torsion bar 68 extending axially between the right hand end of compliant section 69 and the input alignment key pin 66.

The Examiner's reference to claim 3 on page 3 of the Action, first full paragraph, cites Phillips' teaching of redundant sensors 100a and 100b. Nothing of this nature is disclosed or claimed by applicants and does not seem to be relevant to the question of obviousness under §103. Furthermore, the statement made by the Examiner: "Further connecting the sensors at appropriate locations suitable for determining failure at the location requires only routine skill in

the art." This again misses the point of teaching or suggesting the novelty in applicants' claimed combinations, the interrelationship of the recited component parts and their function and operation relative to one another to achieve the desired results.

In view of the foregoing, the Examiner's statement on page 3, second full paragraph, referring to claim 5, is obviously incorrect for the reasons stated above. In support of the Examiner's rejection claims 7-8, 10-12 and 14, the Examiner relies on his reasoning relied on in rejection of claims 1 and 3-5. Accordingly, the rejection of claims 7-8, 10-12 and 14 is also clearly in error at least for the reasons stated above.

Office Action Section 4 sets forth the grounds for rejection of claims 2, 6, 9 and 13 under 35 USC §103 (a), as also allegedly being unpatentable over Phillips '892 combined with applicants' admitted prior art (AAPA). The "shunt mechanism" as claimed in these claims is set forth as a preferred feature and adjunct to the novelty of the basic torque sensor system, and is not claimed as a novel element per se. Indeed, Phillips shows a shunt mechanism in terms of the input shaft 62 that has its three teeth 96a,b,c intercoupled loosely with the three teeth 98a,b,c of pinion shaft 64. Hence, if torsion bar 68 breaks, teeth 96a,b,c of torsion bar 62 will directly engage the teeth 98a,b,c of pinion shaft or "shunt" 64 to thereby bypass manual steering torque around torsion bar 68 and thus provide a parallel mechanical path to directly connect input torque from steering column 16 to gear assembly 70/72. Indeed, Phillips describes his device of FIGS. 2 and 3 as an exemplary combined torque transducer and back-up coupling assembly 92 (see column 9, lines 32-46 and column 10, lines 48-62 of Phillips '892).

Referring specifically to the claims under consideration, claim 1 defines a torque transducer sub-combination that includes first and second stage torsion bars connected in series wherein the first bar has a higher torsional stress in torque transmitting operation than the second

stage torsion bar, and a torque sensor operably coupled to the second stage torsion bar for measuring torque as a function of stress in the second stage bar independent of the first stage torsion bar. Neither of these concepts as expressed in claim 1 is shown in the cited prior art Phillips '892 reference.

Claim 2 is dependent on claim 1 and therefore distinguishes patentably over Phillips for the same reasons as claim 1. Claim 2 recites further novelty in calling for a torsion overload shunt bridging both first and second differential torsion bar stages, rather than bridging just a one-stage torsion bar as in Phillips '892.

Claim 3 is dependent on claim 1 and further defines novelty in calling for a failure sensor coupled across the input of the first torsion bar stage and the input of the second torsion bar stage and operable to provide a sensor signal indicative of failure of either of the torsion bars. Nothing of this nature is shown or suggested in Phillips '892.

Dependent claim 4 is dependent on claim 1 and further defines novelty in calling for the first and second stage torsion bars as a single integrally formed torsion bar with a first section of the torsion bar comprising the first stage and having a lesser cross sectional dimension that a second section of the single torsion bar forming the second stage. Again, nothing of this specific novelty is shown in the cited prior art.

Claims 5, 6 and 7 call for an automotive steering two-stage torque sensor and specifically applies the novel sub-combination of claim 4 to an automotive steering system. Claims 6 and 7 recite features of claims 2 and 3 but are dependent on claim 5. Accordingly, system claims 1-7 recite various and several important novel features over the cited prior art and therefore clearly define non-obvious subject matter, and merit patentability under any determination that is applicable legally to assessing patentability under 35 USC §103.

Claims 8-13 are method claims wherein method steps are recited that bring out the novel features recited above with respect to the apparatus claims, but which are novel from a method standpoint also. Accordingly, claims 8-14 are likewise clearly patentable under 35 USC §103 over the cited Phillips '892 patent.

Applicable Legal Principles

In addition, it is respectfully submitted that the Examiner's stated rejection is tantamount to the "obvious to try" type rejection that has been clearly and repeatedly ruled improper under 35 USC §103 by the Federal Circuit. The standard of 35 USC §103 is not that it would be obvious for one of ordinary skill in the art to try to achieve the invention; indeed, disregard for the nonobviousness of the results of the "obvious to try" experiments disregards "invention as a whole" concept of §103. See in re O'Farrel 7 U.S.P.Q. 2d 1673 (Fed. Cir. 1988); Hybritech Inc. v. Monoclonal Antibodies, Inc., 231 U.S.P.Q. 81 (Fed. Cir. 1986); in re Antonie, 95 U.S.P.Q. 6 (CCPA 1977).

In addition, in view of the foregoing factual technical analysis of Phillips '892, it is respectfully submitted that the Examiner has failed to articulate the requisite teaching, suggestion or motivation to combine references (whether Phillips alone or with AAPA or with the unsupported skill-in-the art assertion) as required to render the claims at issue obvious under 35 USC §103. Indeed, Phillips and AAPA cannot be combined, based on the Phillips disclosure, to produce the torque transducer sub-combination or automotive steering system as set forth in the claims discussed hereinabove. Thus, the Examiner has made no particular findings nor set forth the findings regarding the locus of the suggestion, teaching or motivation to combine the cited prior art reference with his unsupported skill-in-the art suggestions or with the AAPA, as consistently required by the Federal Circuit. Therefore, it is respectfully submitted that the

Examiner has failed to present a *prima facie* case of obviousness of applicant's invention as claimed in claims 1-14 as originally filed.

To establish *prima facie* obviousness of a claim to an invention, all the claim limitations must be taught or suggested by the prior art. In re Royka, 490 F.2d 981, 180 U.S.P.Q. 580 (CPPA 1974). "All words in a claim must be considered in judging the patentability of that claim against the prior art." In re Wilson, 424 F.2d 1382, 165 U.S.P.Q. 494, 496 (CPPA 1970). If an independent claim is nonobvious under 35 USC 103, then any claim depending therefrom is nonobvious. In re Fine, 837 F.2d 1071, 5 U.S.P.Q. 2d 1596 (Fed. Cir. 1988) (MPEP 2143.02).

As set forth in MPEP 2142, if the Examiner does not produce a *prima facie* case, the applicant is under no obligation to submit evidence of nonobviousness. Further, to establish a *prima facie* case of obviousness, three basic criteria must be met.

First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Such a suggestion or motivation is not to be found in Phillips '892 or AAPA.

Second, there must be a reasonable expectation of success. This is rather difficult to establish here where the basic claimed concepts are not found in the prior art.

Thirdly, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Clearly this cannot be said of Phillips '892.

The teachings or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, and not based on applicant's disclosure (as is the case in the instant application). In re Vaeck, 947 F.2d 488, 20 U.S.P.Q. 2d (Fed. Cir. 1991). The initial burden is on the Examiner to produce some suggestion of the desirability of

doing what the inventor has done. "To support the conclusion that the claimed invention is directed to obvious subject matter, either the references must expressly or impliedly suggest the claimed invention or the Examiner must present a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references." (underscoring added) (MPEP 2142) citing Ex parte Clapp, 227 U.S.P.Q. 972, 973 (Bd. Pat. App. & Inter. 1985). It is respectfully submitted that the present rejection clearly fails to meet the foregoing legal criteria.

In view of the foregoing amendments and remarks, it is respectfully submitted that this application now appears to be in condition for allowance with claims 1-14 as originally filed. Accordingly, such action is respectfully solicited.

Respectfully submitted,

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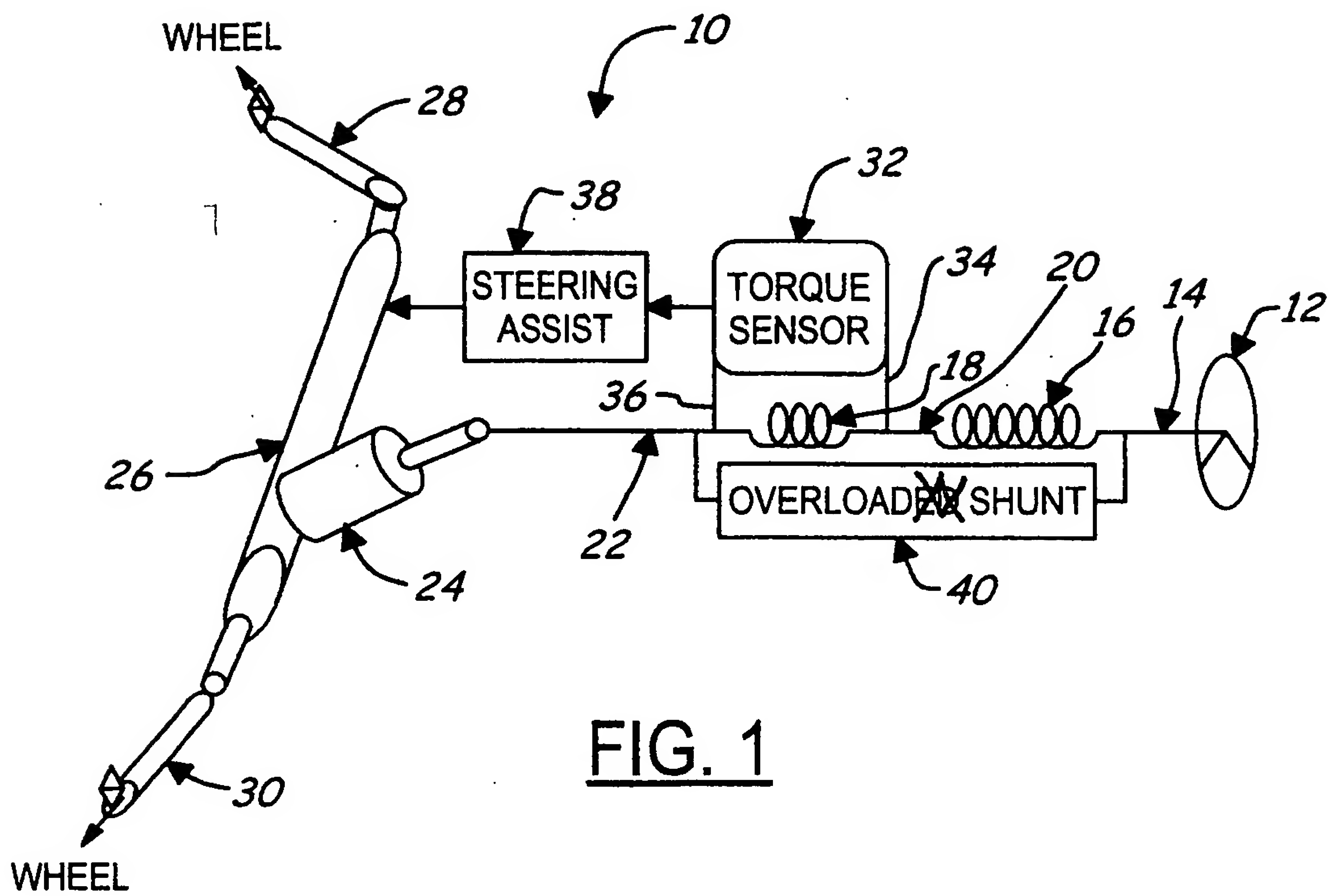
Enclosures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28
38
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STEERING ASSIST
TORQUE SENSOR
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20
14
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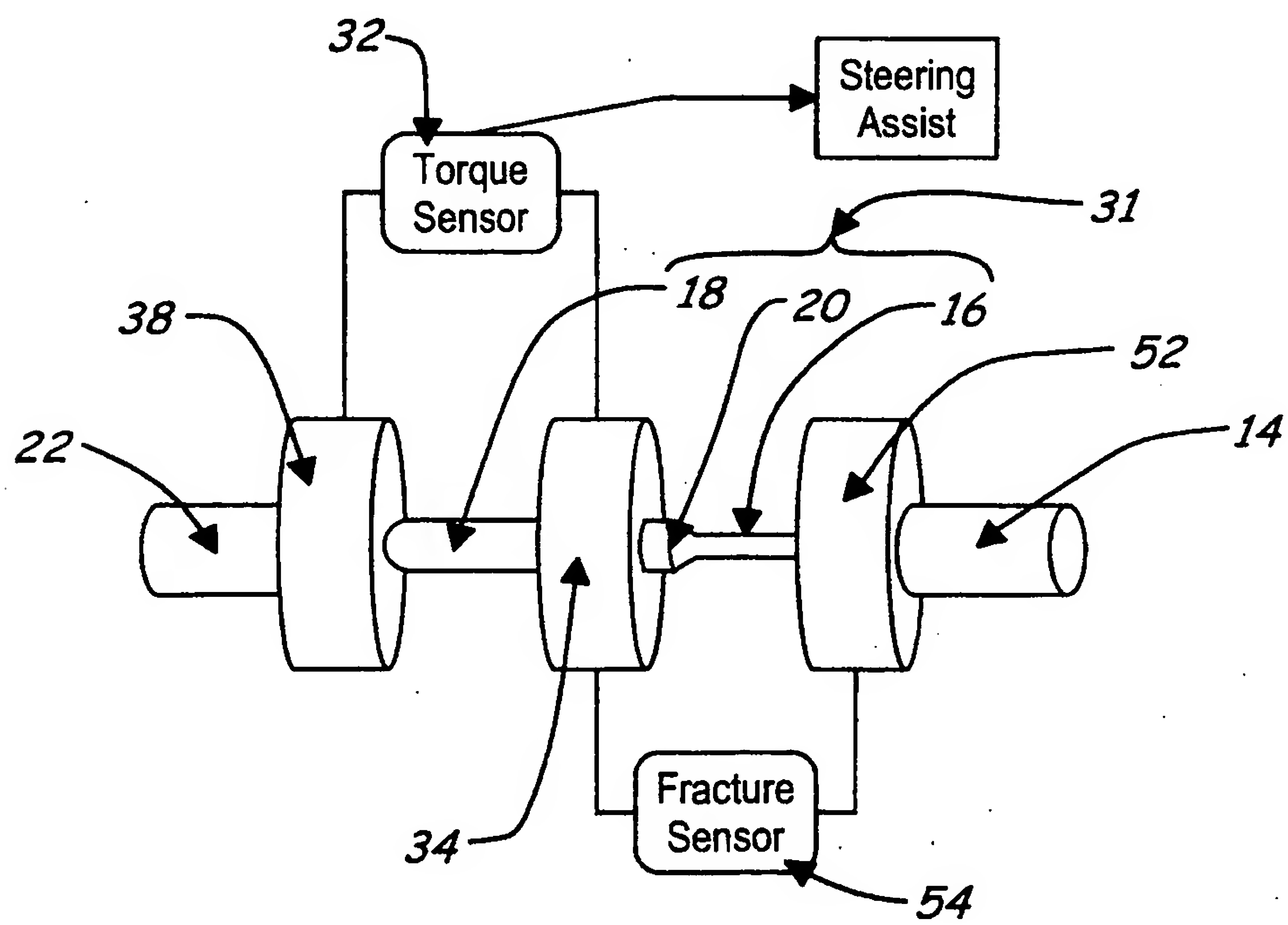
12
18
36
26
22
OVERLOAD~~ER~~ SHUNT
24
40
30
WHEEL

FIG. 1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Steering Assist
Torque Sensor
31
38
18
20
16
52
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Fracture Sensor
34
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FIG. 2